

Epidemiology of arterial hypertension in patients scheduled for elective hip replacement

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Abstract

Background: Assessment of blood pressure values and early diagnosis of hypertension are especially important in high-risk group, including patients in preoperative and postoperative period. The aim of the current study was the assessment of blood pressure values and prevalence of hypertension in patients undergoing elective hip replacement surgery — an orthopedic procedure associated with one of the highest cardiovascular complication rate.

Material and methods: Two hundred and eighty-four consecutive patients admitted for elective hip replacement surgery were screened for arterial hypertension. All patients had their medical records reviewed for prior diagnosis and had their blood pressure measured on admission by a qualified physician prior to the procedure, according to the current guidelines.

Results: The mean age of the study population was 62.2 ± 13.9 years and 42.7% of the patients were male. The body mass index (BMI) in the study population was 27.0 ± 4.2 kg/m². Fifty-eight point two percent of patients were diagnosed with arterial hypertension previously. Mean blood pressure values on admission for systolic blood pressure (SBP) and diastolic blood pressure (DBP) were 134.5 ± 20.4 and 78.6 ± 13.1 mm Hg, respectively. In 43.2% of patients, the on admission blood pressure values exceeded the threshold of ≥ 140 and/or 90 mm Hg. Arterial hypertension was diagnosed *de novo* in 33 (15.0%) patients. Patients with the disease were older (67.5 ± 12.3 vs. 54.4 ± 13.9 years; $p < 0.0001$), and had higher BMI (27.6 ± 4.3 vs. 26.2 ± 3.8 kg/m²; $p = 0.05$) than patients without the diagnosed disease. Diabetes mellitus was more often found in hypertensive patients (13.3% vs. 3.3%; $p = 0.02$), they also more often had history of myocardial infarction ($p = 0.02$), stable coronary artery disease ($p = 0.001$) and heart failure ($p = 0.006$) compared to patients without the diagnosis.

Conclusions: The majority of patients scheduled for elective hip replacement surgery is diagnosed with arterial hypertension. The disease is also diagnosed *de novo* in 15% of these patients. Screening for arterial hypertension is important in this group of patients and can potentially reduce the complication rates of the hip replacement surgery.

Key words: arterial hypertension, orthopedics, hip replacement

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Background

Arterial hypertension is one of the most prevalent chronic diseases [1]. The comparison of results of NATPOL 2011 and NATPOL demonstrate that in Poland the number of people suffering from arterial hypertension is 2% higher than a decade ago. Currently, approximately 32% of adult Poles (10.5

million patients, including 9.5 million aged 18–79 years and almost 1 million patients over 80 years) suffer from arterial hypertension. As many as 30% of this population is not aware of the fact that they are afflicted with the disease and 9% have recognized, but untreated hypertension [2].

The results of large prospective epidemiological studies clearly indicate that hypertension is one of the most important risk factors for cardiovascular diseases such as coronary artery disease, heart failure, or stroke [3]. Moreover, arterial hypertension is responsible for considerable morbidity, mortality, and

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disability, not only in Poland but also across the Europe and the United States [4]. Even the “high-normal” blood pressure values, still within the normal range, have been linked with a higher incidence and severity of various cardiovascular disease risk factors such as obesity, dyslipidemia or glucose intolerance [5].

Assessment of blood pressure values and early diagnosis of hypertension is especially important in high-risk group, including patients in preoperative and postoperative period. Hypertension correlates with higher perioperative risk leading to severe and minor cardiovascular complications [6]. The aim of the current study was the assessment of blood pressure values and prevalence of hypertension in patients undergoing elective hip replacement surgery — an orthopedic procedure associated with one of the highest cardiovascular complication rate.

Material and methods

We performed an observational cohort study in order to establish the prevalence of arterial hypertension in consecutive Polish patients undergoing total hip replacement surgery in a tertiary University Hospital. The study was conducted with respect to the Declaration of Helsinki and an approval form the Ethics Committee by the Medical University of Warsaw was obtained before the beginning of the study. Written, informed consent was obtained from every study participant prior to the study enrolment.

The study cohort consisted of 284 consecutive patients who were hospitalized in a high-volume tertiary university orthopedic clinic for total hip replacement surgery between 2009 and 2013. All patients were qualified for the surgery procedure following current orthopedic criteria. The study population consisted of patients in whom the operation was successfully performed, and in whom the medical records allowed valid assessment of blood pressure values and current medical treatment.

Exclusion criteria were: age < 18 or ≥ 75 years, prior hip homolateral hip replacement surgery, stroke or decompensation of heart failure within the last six months and absence of written informed consent. Registry was screened to identify all patients who received one or more elective primary total hip or knee replacements in the study period. Patients treated with non-elective hip arthroplasty for hip fracture were excluded. For patients who underwent more than one operative procedure during the study period, only the first procedure was considered; thus, only one operative episode was examined for each patient.

Data on demographics, lifestyle, comorbidity and cardiovascular risk factors were obtained. Demographic variables analyzed included age and sex. Comorbidities studied included presence or absence of heart failure, diabetes mellitus, stroke or TIA episodes, myocardial infarction episodes, peripheral artery disease, dyslipidemia, coronary artery disease, important valvular defect, asthma, chronic obstructive pulmonary disease, CABG, PCI, cardiac pacemaker implanted. All patients were also screened for other classical and non-classical cardiovascular risk factors including diabetes mellitus, dyslipidemia, or history of cardiovascular disease. Diagnosis of all factors was made based on eligible medical records, taking prescription drugs applicable for the respective disease (i.e. hypoglycemic agents for diabetes), or as a *de novo* diagnosis according to the current diagnostic criteria.

All study participants were screened for arterial hypertension. Patients had their blood pressure measured on admission by a qualified physician prior to the surgery procedure. Diagnosis of arterial hypertension was made when office blood pressure were equal or exceeded the values of 140 for systolic blood pressure (SBP) and/or 90 for diastolic blood pressure (DBP). The number of required measurements, measure techniques and settings were in accordance with the current guidelines for arterial hypertension diagnosis and management of the ESC and European Society of Hypertension. The diagnosis was also made where there were eligible medical records available on previous diagnosis of arterial hypertension or taking prescription hypotensive agents.

Statistical analysis was performed using the SAS software version 8.02 (SAS Institute, Inc., Cary, NC, USA). Continuous data are presented as mean ± standard deviation (SD) and were compared using the Mann-Whitney test or Student’s t-test. Categorical variables were compared using either the χ^2 or Fisher’s exact tests. A p value of less than 0.05 was considered statistically significant, whereas the confidence intervals (CI) were 95%.

Results

After applying the inclusion and exclusion criteria, the study covered 220 patients, in whom the total hip replacement procedure was performed. The mean age of the study population was 62.2 ± 13.9 years and 42.7% of patients were male. The body mass index (BMI) in the study population was 27.0 ± 4.2 kg/m². Detailed characteristics of the study population are listed in the Table I. Cardio-

Table I. Baseline characteristics of the study population

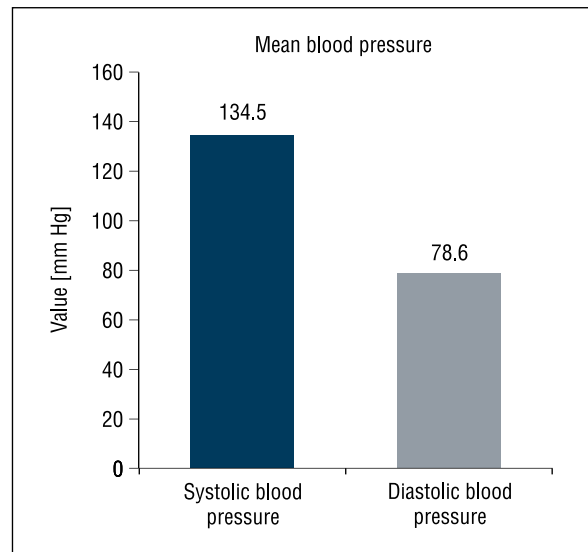
Parameter	Value n = 220
Age (years)	62.2 ± 13.9
Male sex	94 (42.7%)
BMI [kg/m ²]	27.0 ± 4.2
SBP [mm Hg]	134.5 ± 20.4
DBP [mm Hg]	78.6 ± 13.1
HR (beats per minute)	71.3 ± 14.0
Heart failure	10 (4.8%)
Diabetes mellitus	20 (9.1%)
Previously diagnosed arterial hypertension	128 (58.2%)
History of myocardial infarction	12 (5.5%)
History of stroke or TIA	2 (0.9%)
Peripheral artery disease	2 (0.9%)
Diagnosed dyslipidemia	8 (3.6%)
Stable coronary artery disease	22 (10.0%)
Blood pressure values > 140/90 mm Hg on admission	95 (43.2%)

Parameters are presented as mean ± standard deviation or n (%).
BMI — body mass index; SBP — systolic blood pressure; DBP — diastolic blood pressure; HR — heart rate; TIA — transient ischemic attack

vascular diseases and cardiovascular risk factors were not very frequent among the study population. Of the population, 58.2% of patients were diagnosed with arterial hypertension previously, 10% had diagnosed stable coronary artery disease, 5.5% and 0.9% underwent myocardial infarction and stroke previously.

After taking blood pressure on admission, it was shown that mean systolic blood pressure (SBP) and diastolic blood pressure (DBP) values were 134.5 ± 20.4 and 78.6 ± 13.1 mm Hg, respectively (Figure 1). In 43.2% of patients the on admission blood pressure values exceeded the threshold of ≥ 140 and/or 90 mm Hg. Arterial hypertension was diagnosed *de novo* in 33 (15.0%) patients.

After dividing patients according to the presence of previously diagnosed arterial hypertension, it was found that patients with the disease were older (67.5 ± 12.3 vs. 54.4 ± 13.9 years; $p < 0.0001$), and had higher BMI (27.6 ± 4.3 vs. 26.2 ± 3.8 kg/m²; $p = 0.05$) than patients without the diagnosed disease. Also, the prevalence of various comorbidities was significantly different between patients with and without previously diagnosed arterial hypertension. Diabetes mellitus was more often found in hypertensive patients (13.3% vs. 3.3%; $p = 0.02$), they also more often had history of myocardial infarction ($p = 0.02$) and stable coronary artery disease ($p = 0.001$) compared to patients without the diagnosis.

**Figure 1.** Mean blood pressure on admission

Interestingly, the SBP and DBP values were not significantly higher in patients with previously diagnosed arterial hypertension ($p > 0.05$) than in those without the disease, but blood pressure values > 140/90 mm Hg on admission were on the edge of statistical significance for being more prevalent in hypertensive patients (48.4% vs. 35.9%; $p = 0.07$). Detailed information on the group characteristics are presented in Table II.

Discussion

Total hip replacement is one of the orthopedic interventions associated with high thromboembolic risk and mortality rate. Perioperative cardiac events are a leading cause of death after non-cardiac surgery [7–9].

Singh *et al.* have described a population-based cohort of Olmsted County residents who underwent total hip arthroplasty between 1994 and 2008. Ninety-day mortality in this group was 0.7%, thromboembolic events, including deep vein thrombosis and pulmonary embolism have been estimated on 4% and 6.9% of population has manifested cardiac events (myocardial infarction, arrhythmia, congestive heart failure) [10].

In spite the fact that patients treated with total hip replacement have a lower comorbidity score than the whole arthritis population, they are at high risk for fatal complications [7]. Numerous high mortality risk factors have been described and divided into modifiable and non-modifiable. The most important are associated with early 90-day mortality and include: fatal myocardial infarction, pulmonary

Table II. Patient characteristics according to the presence of previously diagnosed hypertension

Parameter	Non-hypertensive patients (n = 92)	Patients with previously diagnosed hypertension (n = 128)	p value
Age (years)	54.4 ± 13.9	67.5 ± 12.3	< 0.0001
Male sex	45 (48.9%)	49 (38.3%)	0.13
BMI [kg/m ²]	26.2 ± 3.8	27.6 ± 4.3	0.05
SBP [mm Hg]	130.6 ± 16.7	137.2 ± 16.7	0.07
DBP [mm Hg]	77.7 ± 10.9	79.2 ± 14.5	0.50
HR (beats per minute)	71.1 ± 13.7	71.5 ± 14.2	0.58
Heart failure	0 (0.0%)	10 (8.3%)	0.006
Diabetes mellitus	3 (3.3%)	17 (13.3%)	0.02
History of myocardial infarction	1 (1.1%)	11 (8.6%)	0.02
History of stroke or TIA	0 (0.0%)	2 (1.6%)	0.51
Peripheral artery disease	1 (1.1%)	1 (0.8%)	1.00
Diagnosed dyslipidemia	1 (1.1%)	7 (5.5%)	0.14
Stable coronary artery disease	2 (2.2%)	20 (15.6%)	0.001
Blood pressure values > 140/90 mm Hg on admission	33 (35.9%)	62 (48.4%)	0.07

Parameters are presented as mean ± standard deviation or n (%).

BMI — body mass index; SBP — systolic blood pressure; DBP — diastolic blood pressure; HR — heart rate; TIA — transient ischemic attack; AF — atrial fibrillation

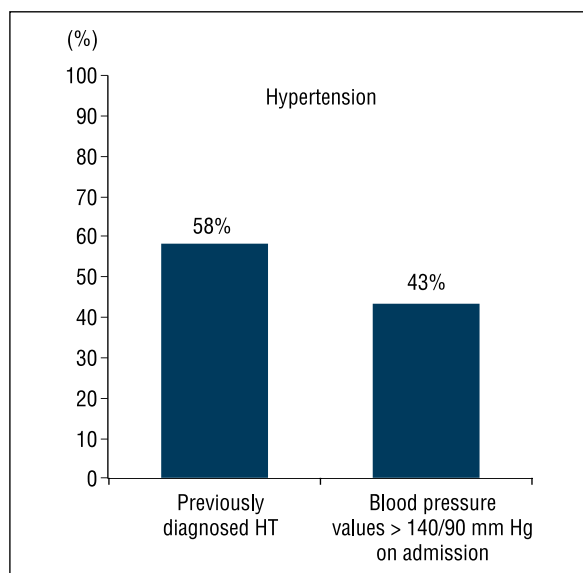


Figure 2. Prevalence of previously diagnosed arterial hypertension versus patients with blood pressure values meeting the criteria for hypertension diagnosis

BP — blood pressure, HT — arterial hypertension

embolism, postoperative hyperglycemia or elevated perioperative creatinine concentration [7, 8]. It is also confirmed that the elderly patients especially with history of dementia, preoperative anemia and prolonged hospital stay are more likely to die in the early postoperative period [8]. However, total risk of serious complications after arthroplasty is not significantly

high. Available literature reveals that thromboembolic complications such as venous thromboembolism and pulmonary embolism are classified as one of the most frequent, especially among elderly patients [6, 11].

For all these reasons it is important to estimate total cardiovascular and thromboembolic risk before surgery in order to reduce mortality in patients undergoing hip replacement.

The thromboembolic risk stratification, especially important in prothrombotic states such as hip replacement, is currently facilitated with few popular risk assessment schemes. The most widely used, most of all in atrial fibrillation patients, but also acute coronary syndromes, pulmonary embolism or prediction of erectile dysfunction is the CHA₂DS₂-VASc score [12–14]. In the CHA₂DS₂-VASc score, as well as in other prediction schemes, the arterial hypertension is recognized as a thromboembolic risk factor [15]. Previous research suggests that hypertension is the most prevalent stroke risk factor (67.3%), followed by coronary artery disease (38.4%). The systematic review emphasizes the importance of arterial hypertension, prior stroke/TIA, advancing age and diabetes as a stroke risk factors. On the other hand, vascular diseases, including myocardial infarction, peripheral artery disease, and complex aortic plaque increase TE risk in AF [15].

Therefore, in patients undergoing hip replacement early diagnosis of arterial hypertension can help facilitate the decision on proper management

and suitable thromboembolic prophylaxis introduction. Assessment of the blood pressure values is important also for the preoperative and postoperative management outside of the coagulation control. It was observed that patient with untreated hypertension had greater decrease in blood pressure and were more exposed to myocardial infarction [16].

Hypertension undoubtedly correlates with higher perioperative risk leading to severe and minor complications including: cardiovascular death, myocardial infarction, heart failure, cerebrovascular accidents and perioperative tachycardia or bradycardia [16]. Moreover, labile blood pressure values may be strongly associated with types of anesthetic drugs used in surgery procedure [16, 17]. Hypertensive patients seem to have higher cardiovascular lability during anesthesia due to increased systemic vascular resistance [16, 18]. They are also more sensitive to intubation and laryngoscopy during operation [16, 19]. All these factors have an effect on operation progress and perioperative complications risk. All hypertensive patients should be treated appropriate prior to elective surgical procedure in order to avoid unwanted events during and after surgery [16].

A new predictive model was recently developed to assess the risk of intra-operative/post-operative myocardial infarction or cardiac arrest, using the American College of Surgeons National Surgical Quality Improvement Program (NSQIP) database. The model incorporates risk factors, such as type of surgery, functional status, elevated creatinine (> 130 mmol/L or > 1.5 mg/dL), American Society of Anesthesiologists (ASA) class, age and is an easily applicable clinically based scheme [9, 20].

Also, current 2014 European Society of Cardiology guidelines on cardiovascular assessment and management during non-cardiac surgery mention the significance of cardiovascular risk estimation prior to the procedure [20]. According to guidelines, clinical risk indices are recommended to be used for peri-operative risk stratification. Effective strategies aimed at reducing the risk of perioperative cardiac complications should be considered for two reasons. Firstly, low-cardiac risk patients can be operated without further delay. Secondly, risk reduction by pharmacological treatment is most effective in patients with a suspected increased cardiac risk. Several risk indices have been developed during last 30 years [20].

Conclusions

Majority of patients scheduled for elective hip replacement surgery is diagnosed with arterial hyperten-

sion. Most of the patients have good blood pressure control, but in some cases, the disease is diagnosed *de novo*. Screening for arterial hypertension is important in this group of patients and can potentially reduce the complication rates of the hip replacement surgery.

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